Space Weather Technical Forecast

Issued on Saturday, 01 April 2023 at 12:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of both Minor Radio Blackouts and Minor Geomagnetic Storms easing today. Active electron fluence becoming Likely into UTC weekend.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with Several C-class flares observed, the largest of which was a C9.7 at 31/2057 UTC.

There are currently four numbered and three unnumbered sunspot regions on the disc. All appear to be small and simple with very little magnetic complexity. AR3265 approaches the northwest limb and is becoming increasingly difficult to analyse, therefore it's previous analysis is conserved. One unnumbered region to the west of AR3264 has re-emerged.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by ACE and DSCOVR, was characterised by the fast wind associated with CH88/-. Solar wind speeds were Slightly Elevated to Elevated, 460-550 km/s. Density was around average. The phi angle was mostly negative (towards the Sun) but with periodic fluctuations to positive (away from the Sun). The IMF was weak (below 8nT), with fluctuations between +6/-5nT in the north-south component. The result of the above solar wind measures was for Quiet to Unsettled (Kp 0-3) geomagnetic activity, with one Active interval (Kp 4) 31/2100-01/0000 UTC.

Energetic Particles / Solar Radiation: High energy proton enhancement (greater than 10MeV) has been at background levels.

The high energy electron flux (greater than 2MeV), as measured at GOES16 has been at moderate to high levels, with a peak of 1.52e3 pfu observed at 01/1155 UTC. The associated 24-hour fluence has been below the Active (1e8 integrated pfu) threshold throughout but on a rising trend, recording 3.12e7 integrated pfu at 01/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low, though there continues to be a slight and reducing chance of activity rising to Moderate given any isolated low level M-class flares that may occur.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs are expected, though there are up to three CMEs presenting a very slight chance of glancing blows at Earth on 2nd April.

Earth appears to still be in lingering effects of CH88/-, with speeds still at Elevated levels. Solar winds should ease through the period, likely becoming slightly elevated or slow/ambient by 2nd April. There remains an outside chance of solar winds briefly increasing on 2nd April due to glancing CME impacts. Solar wind speeds then expected to rise to Elevated or perhaps briefly Strong upon the arrival of the HSS of CH90/- late on day 3 or day 4 (3rd or 4th).

Quiet to Unsettled geomagnetic activity is expected days 1 and 2 (1st and 2nd), with a chance of Active intervals and a slight chance of G1/Minor Storm intervals due to lingering CH HSS and subsequent possible CME glancing blows. From late day 3 until day 4 (3rd & 4th), Unsettled to

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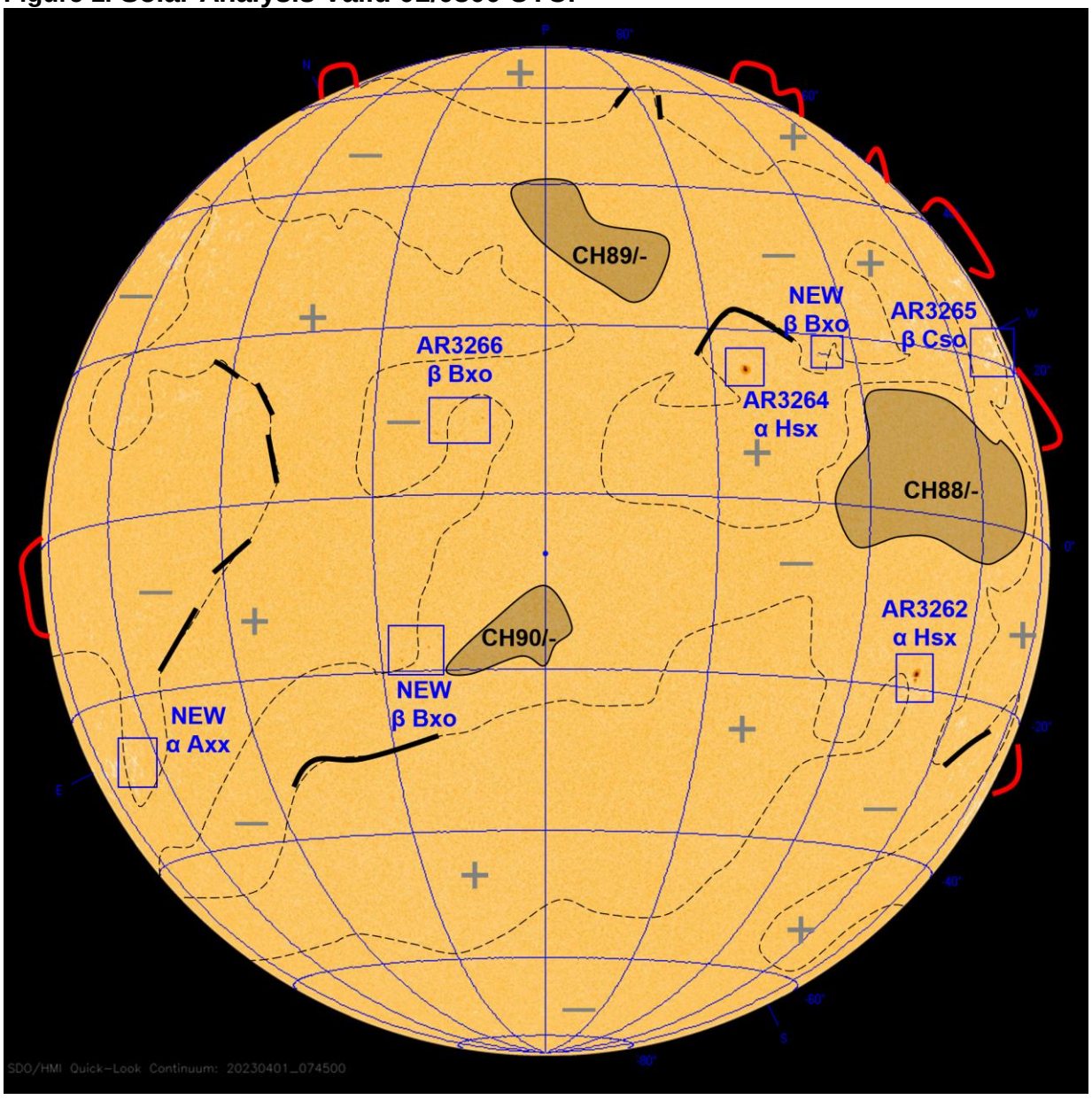
Active geomagnetic activity is most likely, with a chance of G1/Minor storming due to the arrival of the CH HSS of CH90/-.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES-16 is at background levels and is likely to remain at such.

The flux at GEO has been at Moderate to High levels through the period. This is likely to continue due to the waning effects of the HSS from CH88/-. Fluence levels are likely to continue rising in response to the elevated flux levels, likely rising above the Active threshold later day 1 and into day 2 (1st and 2nd). This may last through the period until the HSS from CH90/- arrives by day 4 (4th).

Figure 1. Solar Analysis Valid 01/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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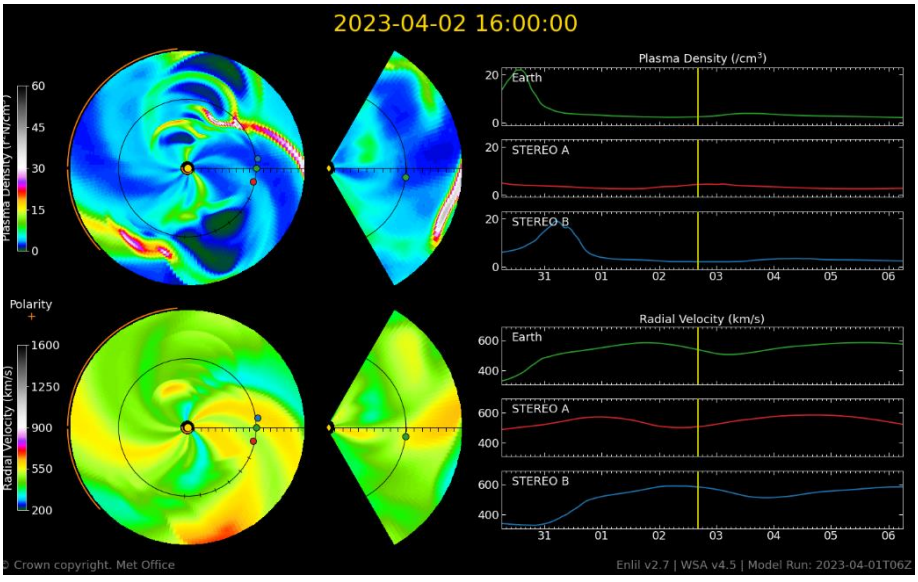
Geomagnetic Storms:

No Earth Directed CMEs are expected, though there are up to three CMEs presenting a very slight chance of glancing blows at Earth on 2nd April, the most evident of these is the 29 March prominence eruption from the southeastern limb. The deterministic MOSWOC Enlil run has this as a miss. There are a couple other CMEs awaiting results in ENLIL, though these are currently not expected to have a major Earth-directed component.

The Earth appears to still be in a CH HSS, probably lingering effects of CH88/-, with speeds still at Elevated levels. Solar winds should ease through the period, likely becoming slightly elevated or slow/ambient by 2nd April. There remains an outside chance of solar winds briefly increasing on 2nd April due to glancing CME impacts. Later Day 3 and into Day 4 Earth will likely begin to see the effect of approaching coronal holes 89 and 90, with CH90/- in the southern hemisphere expected to be the dominate feature. Solar wind speeds expected to rise to Elevated or perhaps briefly Strong.

Quiet to Unsettled geomagnetic activity is expected 1st and 2nd, with a chance of Active intervals and a slight chance of G1/Minor Storm intervals due to lingering CH HSS and subsequent possible CME glancing blows. From late 3rd or early 4th, Unsettled to Active geomagnetic activity is most likely, with a chance of G1/Minor storming due to the arrival of the CH HSS of CH90/-

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	30	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1



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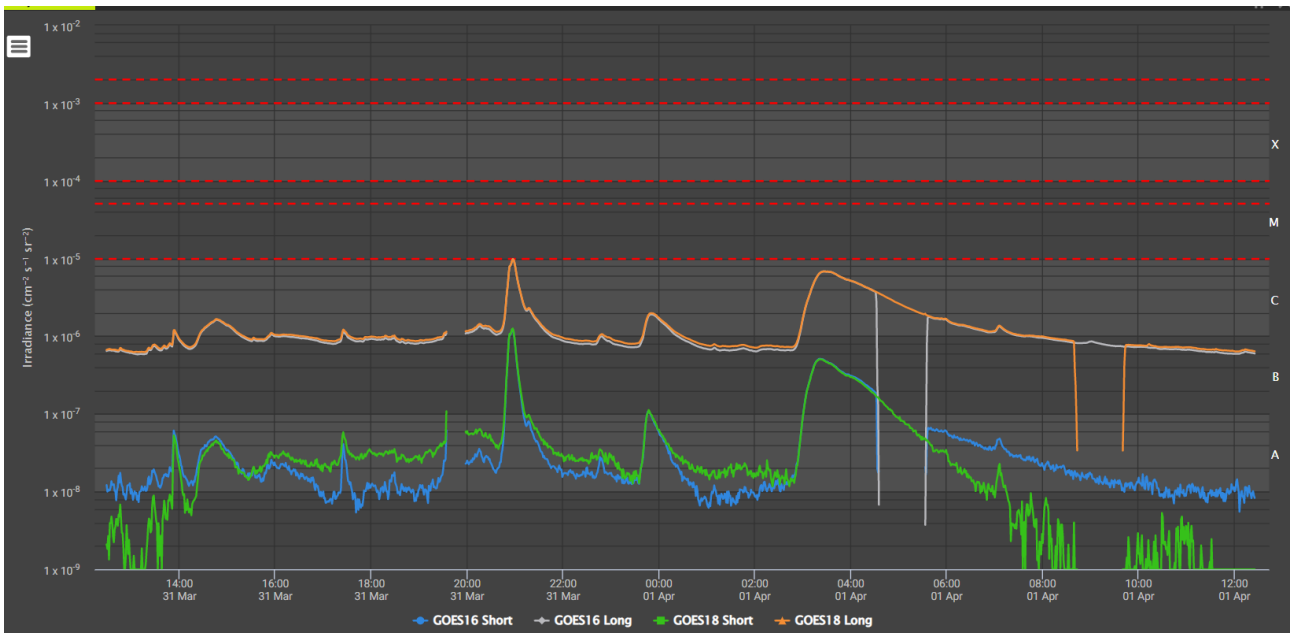
Radio Blackouts - X-Ray Flares:

The four-day forecast period is currently expected to see a gradual reduction in flare risk due to AR3256 and AR32625 rotating around the western limb. Currently it is expected that only relatively few, simple regions will remain.

Meanwhile, in the east, multiple returning regions signalled to potentially arrive during the period, although for now there are no major signs of increased activity from STEREO A EUVI imagery or flux looping from beyond the limb. Soundings suggest the most active of these region most likely into Day 4, but these regions will be assessed as and when they present for analysis.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	15	10	5	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: 24 hour X-Ray trace



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES-16 is at background levels. There is non-zero chance of enhancements due to any Strong flares which may occur from AR3656 which is now beyond the western limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The flux at GEO has been at Moderate to High levels through the period. This is likely to continue due to the waning effects of the HSS from CH88/-. Fluence levels are likely to continue rising in response to the elevated flux levels, likley rising above the Active threshold later day 1 and into day 2 (1st and 2nd). This may last through the period until the HSS from CH90/- arrives by day 4 (4th).

MOSWOC REFM is perhaps a little muted in its expected response, with something more similar to persistence preferred.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	70	80	60	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	5	1

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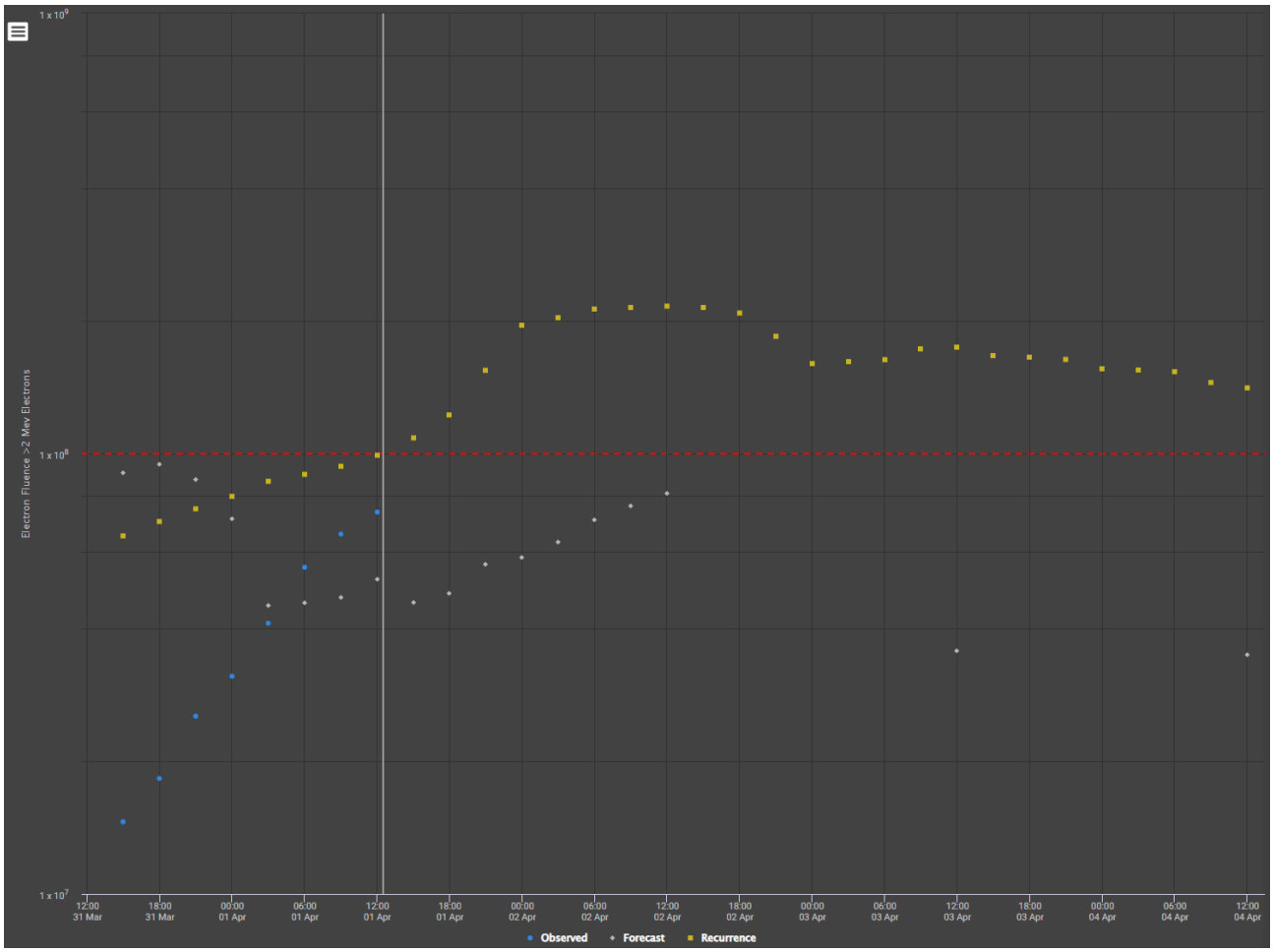
Figure 5: MOSWOC REFM



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